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FY 2002 – FY 2005

CENTRAL ASIA NATURAL RESOURCES MANAGEMENT PROGRAM

TRANSBOUNDARY WATER AND ENERGY PROJECT

USAID/Water IQC TO 809

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ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank
BVO	River Basin Water Management Organization
NAS	Northern Aral Sea model of SYNAS project
CAPS	Central Asian Power System
CSI	Campbell Scientific Instruments
DSS	Decision Support System
GIS	Geographical Information System
ICWC	Interstate Commission for Water Coordination
IFAS	International Fund for Saving the Aral Sea
IPD	Intellectual Portable Device
IWEC	International Water and Energy Consortium
JSC	Joint Stock Company
MAWR	Water Resources Department of the Ministry of Agriculture and Water Resources of the Republic of Uzbekistan
MCC	Meteor Burst Communications Corporation
NASPI	Naryn Syr Darya Planning Instrument
NOPI	Naryn Operation Planning Instrument
NRMP	Natural Resources Management Program
SEA	Kyrgyz State Energy Agency
SECO	Swiss State Secretariat for Economic Affairs
SIC-ICWC	Scientific Information Center at the Interstate Commission for Water Coordination
SYNAS	Syr Darya and Northern Aral Sea project (World Bank)
TO	Task Order
TWEP	Transboundary Water and Energy Project

UDC	Unified Dispatch Center
USAID	United States Agency for International Development
USAID/CAR	USAID Mission to the Central Asian Republics
WEN	Water-Energy Nexus Spreadsheet

1. INTRODUCTION

The United States Agency for International Development, Regional Mission for Central Asia (USAID/CAR) issued a Task Order (TO 809) to PA Consulting on 17 December 2001, to conduct the Transboundary Water and Energy Project (TWEP) in conjunction with the Central Asia Natural Resources Management Program (NRMP). TO 809 delineates two phases. Phase I, which was implemented from December 2001 through April 2002, developed the strategy and specific tasks for an effective program of technical assistance to Central Asia water and energy policymakers in transboundary water and energy cooperation. Phase II of TO 809 was the actual project implementation phase for activities as approved by USAID/CAR through work plans. Phase II commenced in May 2002 and was completed in October 2005.

TWEP supported activities that help leaders in Central Asia develop and agree on measures to improve water and energy cooperation. TWEP focused on the Syr Darya Basin where a conflict has arisen between the winter energy needs of Kyrgyzstan, the summer irrigation needs of the downstream riparians, and the timing of environmental flows to the Aral Sea. Kyrgyzstan, Tajikistan, Uzbekistan and Kazakhstan share the Syr Darya Basin. Phase I of the project identified the following activities summarized in the table below, which would help TWEP achieve its objectives. Any of these activities would improve, on a stand-alone basis, the management of the Syr Darya Basin and reduce potential conflicts over water and energy. In the near term, successful implementation of the first two tasks would simplify and stabilize river management, reduce water spillage, provide greater energy security to Kyrgyzstan and water security to downstream users, and eliminate difficulties in annual negotiations on water and energy exchanges.

Task/Action	**Time to Impact of Action**
Reduction of Energy Losses in Kyrgyzstan	Short-term
Improvement of the Implementation of the 1998 Agreement on Water and Energy Use	Short-term
Technical Assistance to Donors and International Finance Institutions (i.e., the Agreement on Power Trade Relations)	Short- to medium-term
Development and Strengthening of Regional Organizations (i.e., IFAS, ICWC, UDC, BVOs)	Short- to medium-term
Initial Assessment of Kambarata 1 and 2 Hydropower Plants	Long-term; part of the structural solution

2. SUPPORT THE IMPLEMENTATION OF THE KYRGYZ ELECTRICITY LOSS REDUCTION PROGRAM

Reducing the high electricity losses in the Kyrgyz energy system during winter was identified as one of the options to mitigate the regional water/energy conflict. A reduction of these losses to a reasonable level would lower the electricity demand from the Toktogul hydropower plant and four downstream hydropower plants, a system known as the Naryn Cascade. Also, increased revenue resulting from better metering, billing and collection practices could provide the financial means for the energy sector to improve existing thermal plants and pay for fuel.

TWEP identified, prepared and implemented three electricity loss reduction demonstration models to complete this task. The objective for the demonstration models was the introduction of successful technologies and practices recently introduced in a few other regions of the former Soviet Union. Each of the three TWEP demonstration models addressed specific recognized issues as summarized below.

Generation demonstration model. A demonstration project at two hydropower plants of the Naryn Cascade was identified to: 1) define the level of losses in Jalal-Abadelectro Distribution Company, 2) bring transparency to the export-import transactions, and 3) serve as part of an overall metering and data acquisition system to reduce system transmission losses. Meters were installed at the switchyard 500 kV, all substations 220 and 110 kV and KRUN 6 kV of the Toktogul and Kurpsay hydropower plants. They would enable the generating company to perform accurate commercial and technical metering and energy balance calculations.

Transmission demonstration model. A demonstration project at the high-voltage substation “Glavnaja” in the town of Bishkek was chosen to address the lack of metering at the delivery point between the transmission and distribution companies. Meters were installed at all 220 kV, 110 kV and 10 kV delivery points. These meters can communicate data to the office of the dispatch center where software was installed to better balance supply and demand. The system also supports accurate accounting and improved billing of distribution companies for the electricity provided.

Distribution demonstration model. Three demonstration projects were identified in the towns of Bishkek, Osh and Cholpon-Ata. They were designed to address the shortcomings in three major areas of operations: 1) internal distribution metering, 2) end-user metering, and 3) customer metering, billing and collection software. Meters were installed at the delivery points feeding from 10 kV lines, at the 0.4 kV transformers and at end-user level. The demonstration projects targeted end-user metering at individual houses and apartment buildings and covered approximately 1,000 customers. The new meters would allow better monitoring of electricity flows to pinpoint losses with a target reduction of 50% of current losses in the pilot areas.

More detailed information can be found in the TWEP/NRMP report entitled “Support to Electricity Loss Reduction in the Kyrgyz Republic - Stage I: Identification of Demonstration Projects” dated September 23, 2002. This report provides general information about the electricity sector of the Kyrgyz Republic and discusses existing problems, including sources of losses and describes the approach to the demonstration models.

Since major financial losses occur in the distribution sector, special attention was given to the three demonstration models in the selected pilot areas. These pilot areas were carefully monitored to obtain the data and analyze results regarding electricity losses. The results and recommendations of the TWEP team are presented in the reports entitled "Electricity Loss Reduction Demonstration Models - Initial Performance Monitoring Results for Severelectro and Oshelectro Pilot Areas" dated July 21, 2004; and "Electricity Loss Reduction Demonstration Projects - Final Performance Monitoring Results for Distribution Sector" dated July 13, 2005.

To disseminate the findings of the above-mentioned reports TWEP/NRMP organized two roundtable meetings. On September 13-14, 2004, a large meeting was held to develop an action plan to stabilize the energy sector by eliminating electricity losses and theft. The roundtable reviewed the results of the USAID-funded demonstration projects to reduce electricity losses at two electricity distribution companies in Kyrgyzstan. USAID sponsored the roundtable because electricity losses and theft raise electricity costs, increase disruptions of supply and are unfair to those customers who pay their bills. On July 15, 2005, TWEP/NRMP conducted a roundtable meeting for the representatives of the Government, the Kyrgyz State Energy Agency (SEA) and distribution sector to discuss the findings of the final report. TWEP/NRMP presented the performance monitoring results of the demonstration projects conducted at the three distribution companies. During the meeting, the SEA presented its electricity loss reduction program identifying the roles and responsibilities of the regulator and licensees. Each distribution company made its own presentation on their methods of electricity loss reduction. In addition, a guest speaker from Kokshetau Energo in Kazakhstan shared their views and experience on effective ways to reduce electricity losses.

Within this task, two study tours were organized for the energy sector representatives. The first study tour demonstrated to Kyrgyz professionals the technology and approach used in the Armenian power sector to reduce commercial losses, support privatization of the Distribution Company and implementation of a sound power market structure, which assures financial viability of the sector. Another study tour to Kokshetau Energo introduced participants to the valuable experience that Kazakhstan already gained during the reforms conducted in the energy sector in the mid- and late 1990s. In particular, Kokshetau Energo shared their experiences in reducing electricity losses, and improving the distribution sector and regulatory practices in Kazakhstan. Participants in the study tours represented JSC "National Grids," Distribution Companies, and the SEA.

The findings from performance monitoring of the three electricity loss reduction models could generate "political will" for policy changes regarding the role of the SEA and the management of the electricity distribution companies. Other donors are already replicating the distribution loss reduction models on a larger scale using the results of the USAID demonstrations. The Swiss State Secretariat for Economic Affairs (SECO) and the World Bank are investing more than US $20 million in electricity metering infrastructure and customer metering, billing and collection systems during the next three years. Policy changes and large-scale replication of the loss reduction models should improve regional water and energy cooperation in the near to medium term.

USAID Possible Follow-Up Activities

High electricity losses in the Kyrgyz Republic are not just an internal problem but remain a transboundary issue in the Syr Darya Basin. Immediate actions are needed to resolve the

problem. The USAID electricity loss reduction demonstration projects clearly demonstrated that the problem does not lie in the lack of capital as previously stated by the energy officials. The results showed that further injection of capital would not allow retention of any benefits derived from the projects, unless the utilities are determined to adopt proper managerial practices. However, one of the main obstacles in the energy sector is the lack of "political will". Now when the Kyrgyz Republic seriously discusses the institutional changes in the energy sector, such as establishment of a ministry, it is vital to get the highest commitment to the reforms. If the directive from the political leadership changes then there is a need to develop a clear strategy for further energy sector development.

The following constitutes a simple action plan, which is recommended for implementation if a loss reduction strategy is accepted at the highest political level:

- Implementation of nodal internal metering, which would enable distribution companies to perform internal power flow controls and loss tracking.
- Development of metering, billing and collection software that would have the capacity to track internal power flows and generate management reports. All customers should be consolidated into one database to perform distribution loss control reports.
- Internally, companies should make their authorized personnel responsible for losses in certain segments of the network. In the networks of 35/10/6 kV, the responsibility should be given to the technical department, and in the networks of 0.4 kV to the sales department.
- Companies should perform baseline loss assessment for all segments of the networks and develop loss reduction targets with incentives and penalties for the authorized personnel.
- Payment of electricity bills should be done only through the banking system. Meter readers should not accept any cash from the customers.
- These measures should be performed under strict control of the SEA or Ministry. Once developed, they should approve and oversee the proposed detailed action plans.

3. ASSESSMENT OF KAMBARATA 1 AND 2 HYDROPOWER PLANTS

TWEP prepared an assessment of the Kambarata 1 and Kambarata 2 Hydropower Projects that were designed in the Soviet era but not constructed. These two projects would be located upstream of the Toktogul Reservoir in Kyrgyzstan, so the much larger Toktogul Reservoir could re-regulate water releases from the Kambarata projects to meet both energy and irrigation requirements. The Kambarata 1 Hydropower Project at a cost of about US $1.2 billion, an installed capacity of 1,200 MW and annual energy generation of 4,500 GWh could be a viable project in the future expansion of Kyrgyzstan's power system. The installed capacity could be increased to 1,600 MW, and even higher, to provide peaking capacity for the Central Asian Power System (CAPS). The Kambarata 2 Hydropower Project at a cost of about US $270 million, an installed capacity of 400 MW and annual energy generation of 1,260 GWh could be a low-cost source of peaking power for export to South Kazakhstan or Uzbekistan as part of CAPS.

The initial report “An Assessment of the Kambarata 1 and 2 Hydropower Projects” evaluated these projects in Kyrgyzstan using studies and data from the files of USAID, the World Bank, and several government agencies in the region. The report provided discussion of these projects in the context of Kyrgyzstan’s energy system and also the interconnected Central Asia high voltage transmission grid. TWEP estimated annual energy generation for the projects, singly or in combination, and updated earlier estimates of project costs. The projects are compared to alternative sources of power and energy.

The report's purpose was to help officials in Kyrgyzstan and other states in Central Asia, and potential financing agencies to decide whether or not to proceed with a more detailed assessment of the costs and benefits of these projects. The report also provided information to help promote consensus among the basin states and donor organizations on further action.

TWEP/NRMP conducted two separate workshops to seek the comments of Kyrgyzstan and Kazakhstan power and water sector officials on the initial report “An Assessment of the Kambarata 1 and 2 Hydropower Projects”. The first workshop, held in Bishkek on February 25-26, 2003, led to useful suggestions on technical issues and a valuable exchange of views on the regional aspects of the two projects. Subsequently the report was updated to reflect the findings of the workshop. The updated report concluded that further study of the two projects is justified to refine designs and cost estimates, assess benefits in more detail, and to investigate possibilities for financing. This report recommended a study of staged development of Kambarata 1 to bring the initial cost down to a level that might be more easily financed.

The second workshop was held in Almaty on May 26, 2003, to present the updated report to Kazakhstan power and water sector officials. They found that it provided new information on the performance of these projects and also corrected some misconceptions. The view expressed at the workshops is that Kambarata 1 and possibly Kambarata 2 should continue to be seen as important elements in the long-term development of the Kyrgyzstan and Kazakhstan power systems. An important feature of the Almaty Workshop was a discussion of the near-term water and power problems in the Syr Darya.

After these two workshops, the report on the assessment of Kambarata 1 and Kambarata 2 was revised to reflect the comments and proposals of the Kyrgyzstan and Kazakhstan water

and energy sector officials. The report recommends that initially a working group of experts from Kazakhstan and Kyrgyzstan be set up to develop these proposals in more detail so that they could be considered by all the interested parties, including the other basin countries.

USAID approved the updated report: "An Assessment of Kambarata 1 and 2 Hydropower Projects" dated March 12, 2003. Subsequently, the report was distributed among 30 Kazakh and Kyrgyz water and energy sector experts and decision-makers. The report fully reflects the comments and recommendations of the Kazakh water and energy officials. It presents the actions that need to be implemented in the short to medium-term to improve the weaknesses in the regional water and energy sector, and particularly in Kyrgyzstan, before the development of Kambarata 1 and 2 Hydropower Projects as a long-term solution can be economically and financially justified.

USAID Possible Follow-Up Activities

No further activities are needed. Attention should be given to water-energy nexus issues.

USAID could consider using the Naryn Syr Darya Planning Instrument (NASPI) to investigate the effect of the Kambarata development on improving operation of the Toktogul Reservoir during the vegetation period to reduce the probability and extent of irrigation water deficits downstream of the Naryn River while also reducing the probability and extent of winter power deficits in Kyrgyzstan.

4. IMPROVEMENT OF THE IMPLEMENTATION OF THE 1998 AGREEMENT ON WATER AND ENERGY USE

The purpose of this task was to analyze the present situation, identify the main problems, assess possible remedial measures, and recommend measures for improved water and energy management in the Syr Darya Basin. Taking into account the existing situation there is a need to:

- Improve the operating rules of Toktogul Reservoir,
- Put in place better mechanisms for the downstream users to produce more timely and accurate requests for water from Toktogul Reservoir, and
- Streamline the process of agreements on power and fuel exchanges to stabilize fuel supplies to Kyrgyzstan.

TWEP's approach is based on: 1) adopting fixed rules that would dictate exactly how to operate Toktogul Reservoir in all circumstances, and 2) maintaining the national approach to managing the remainder of the river basin while providing technical support to management decisions. Readily understood simulations of reservoir operation have diagnosed the problem in terms that should, in the near term, lead to practical rules for the operation of the Toktogul Reservoir. These rules are now being tested and refined by the operational managers in Kyrgyzstan. TWEP completed a practical Decision Support System (DSS) for management of the Middle Syr Darya, working together with the BVO Syr Darya.

TWEP's approach does not require comprehensive master planning or optimization for the basin as whole. However, it involves considerable effort in the promotion of consensus among and between national water and energy interests and managers. A strategy for the promotion of consensus was prepared and discussed with USAID/CAR and our counterparts. The following consensus building activities were implemented:

- A paper on the technical part of TWEP's approach was prepared and presented at a Swiss-sponsored water resources management seminar in Almaty (May 6-8, 2004) that was conducted in parallel with a quarterly Interstate Commission for Water Coordination (ICWC) meeting,
- Individual working meetings with technical advisors of ministers,
- Meetings with some of the responsible ministers,
- Meetings with the Asian Development Bank (ADB) to discuss the possibility for a stakeholder workshop that would bring together the key stakeholders to start discussions of the possible/necessary revisions in the 1998 Agreement,
- A detailed exchange of information with the Director of the Scientific Information Center at the Interstate Commission for Water Coordination (SIC-ICWC) to reconcile differing strategies for making immediate improvements to water and energy management in the basin, and

- Meetings on TWEP's report on the Kambarata projects with the Kazakh stakeholders that offered an opportunity to discuss near-term water and power solutions in the Syr Darya with the other riparians.

The events of August 2003 were a dramatic illustration of the need for a more stable operating regime for the Toktogul Reservoir and for better arrangements to manage the sale of surplus hydroelectric energy produced by the Naryn Cascade. In August 2003, the reservoir filled and water had to be released through the spillways of the downstream stations on the Naryn Cascade because Uzbekistan and Kazakhstan chose not to absorb energy in exchange for releases that they did not request. Thus, water that could have been used to produce electricity was wasted, even though it is the lowest cost electrical energy produced in the region.

TWEP developed an initial report entitled "Proposals for Improved Water and Energy Management in the Syr Darya River Basin" that describes the present situation, identifies the main problems, assesses possible remedial measures, and recommends measures that can improve water and energy management in the Syr Darya Basin in the short term. The main recommendations of this report are as follows:

A) The Syr Darya Basin countries should continue to abide by the "1998 Framework Agreement on the Use of Water and Energy Resources between the Syr Darya Basin Countries".

B) The Syr Darya Basin countries should agree to adopt and implement the proposed Toktogul Reservoir Operating Rules that would make the operation of the reservoir more responsive to the demands of Uzbekistan and Kazakhstan. The rules would provide the downstream countries with the opportunity to "bank" water in the reservoir during years when other water resources are plentiful, for use in subsequent "dry" years when other water resources are low. The rules are described in the report.

C) A multi-year Fuel Delivery Protocol should be agreed to that would set an average level of fuel to be supplied to Kyrgyzstan that would be subject to seasonal adjustments by Kyrgyzstan, requested in a timely manner.

Items (B) and (C) might be in the form of an Addendum to the 1998 Framework Agreement. It is also recommended that the DSS be adopted by the BVO Syr Darya. This is a refinement of existing procedures and does not require a formal agreement.

The actions recommended above will lead to more effective water and energy resource management in the Syr Darya Basin. These management tools, linked to better data and information reporting, are not just short-term remedies. Their intent is to diminish friction between the four countries and promote lasting cooperation in water and energy management. At the same time the Syr Darya Basin countries will have to undertake reforms in the electric power and gas utilities.

Based on the follow-up discussions of the report, in three basin countries, except Uzbekistan, there is broad consensus on the need to address the water-energy issues through a regional working group of technical specialists working with common rules, tools and data to facilitate negotiations on regional policy and promote a smoother implementation of those policies. The position of Uzbekistan regarding these policy proposals, including the Regulatory Framework for the implementation of the 1998 Framework Agreement, remains unclear. This view was confirmed in one of the meetings of the ICWC in Bishkek, which

approved a general work plan for the improvement of the 1998 Agreement, including activities of four national working groups and a regional working group. However, the right balance between the different sectors and national interests in these activities is yet to be found.

These working groups would be supported by ADB's regional technical assistance project "Improved Management of Shared Water Resources in Central Asia", which includes objectives related to improvement of the 1998 Framework Agreement. Recently, this ADB project started from its base in Bishkek. It remains to be seen if the ADB project will pursue the full representation of the energy interests in these working groups, as the project is primarily a water resources project. However, if they do and the basin countries, including Uzbekistan, are serious about this activity, then USAID could consider providing technical assistance to these working groups to transfer the TWEP knowledge and tools (such as WEN[1] or the water-energy nexus spreadsheet). This support would be greatly appreciated, as the ADB is a relative newcomer on the Central Asia water-energy nexus.

At the request of USAID, TWEP reviewed the report "A Revised Approach to World Bank and Development Partners' Involvement in the Area of Water-Energy Cooperation in Central Asia", prepared by the World Bank. This report proposes a more realistic and acceptable approach than the previous World Bank report on the water-energy nexus that was heavily criticized in the region, particularly in Uzbekistan, Tajikistan and Kazakhstan. The new approach proposed by the World Bank outlines several valuable measures, including some very complementary with TWEP's efforts, indicating that TWEP's reports and advice have been effective. Nevertheless, TWEP pointed out several inaccuracies in data and analysis in a 7-page note to USAID about the World Bank report.

There are differences between TWEP's approach and the World Bank's proposal for addressing the water-energy problems in the Syr Darya Basin. The Bank's proposal implies a payment to Kyrgyzstan for water deliveries. TWEP believes that the World Bank approach might undo the existing arrangements and put nothing in their place.

TWEP believes that the proposed measures by the World Bank do not entirely resolve the conflicts in water use from Toktogul Reservoir in the short- to medium-term. To achieve a sustainable solution for the operation of Toktogul Reservoir, it is fundamental that all donors make a sustained effort to convey to all parties the message that while we recognize the rights of downstream countries they must understand that the Naryn Cascade (with Toktogul Reservoir) is not just another generation facility in the region but the only source of independent energy security for Kyrgyzstan.

USAID Possible Follow-Up Activities

The latest TWEP report "Proposals for Improved Water and Energy Management in the Syr Darya River Basin", dated January 29, 2004, recommends the following actions:

[1] WEN is an electronic spreadsheet developed to analyze the effect of different levels of seasonal water releases through the Naryn Cascade on power and fuel exchanges according to the 1998 Agreement. The objective of WEN was to forecast the future situation using assumptions about electricity loss reduction and other electricity and heat demand issues in the Kyrgyz Republic. This tool was used in the TWEP report" "Proposals for Improved Water and Energy Management in the Syr Darya River Basin, dated January 29, 2004.

- The Syr Darya Basin countries continue to abide by the "1998 Framework Agreement on the Use of Water and Energy Resources between the Syr Darya Basin Countries".
- The Syr Darya Basin countries agree to adopt and implement Toktogul Reservoir Operating Rules that would make the operation of the reservoir more responsive to the water demands of Uzbekistan and Kazakhstan during the summer irrigation season (April-September). The rules would provide the downstream countries with the opportunity to save water in the reservoir during years when other water resources are plentiful, for use in subsequent "dry" years when other water resources are low. The rules would also prevent over-filling or complete emptying of the reservoir.
- The Syr Darya Basin countries agree on a Multi-Year Electricity-Fuel Exchange Protocol as an urgent measure that would give Kyrgyzstan more stable fuel supplies in exchange for the variable surplus hydroelectricity generated at the Naryn Cascade as a result of water releases from Toktogul Reservoir requested by Uzbekistan and Kazakhstan.
- The Syr Darya Basin countries agree to develop a Regulatory Framework for the 1998 Agreement as a permanent guideline to the implementation of the Agreement. This will consist of guidelines for the development of a single tariff policy, including power transmission and fuel transport fees, and would include the rules for a regional energy exchange pool in line with the objectives for operation of existing facilities by the International Water and Energy Consortium (IWEC).

5. DEVELOP RIVER BASIN MANAGEMENT TOOLS (KZ, KG, TJ, & UZ)

Development of river basin management tools was an important TWEP activity to help leaders in Central Asia develop and agree on measures to improve water and energy cooperation. TWEP focuses on the Syr Darya Basin where a conflict has arisen between the winter energy needs of Kyrgyzstan, the summer irrigation needs of the downstream riparian countries, and the timing of environmental flows to the Aral Sea. Kyrgyzstan, Tajikistan, Uzbekistan and Kazakhstan share the Syr Darya Basin.

TWEP worked with counterparts to develop the DSS for the Middle Syr Darya Basin and NASPI. These tools will improve and stabilize the management of the Syr Darya Basin under any scenario of regional cooperation. Linked to better data and information reporting, the DSS will diminish friction between the countries and promote lasting cooperation in water management.

Decision Support System (DSS)

BVO Syr Darya faces two problems in managing the Middle Syr Darya. One is the difficulty of predicting as early as possible in spring what will be the total available water resource in the summer. The second is coordination and agreement of revisions to the water resource management plans throughout the season in an environment of uncertain water resources. If estimates of the water resources available early in the season prove to be too high, a sharp downward adjustment has to be made to the canal diversions in mid-season and this creates problems for the irrigators and farmers.

TWEP determined that management of the Middle Syr Darya by BVO Syr Darya would be improved by a DSS that: 1) improves prediction of water resources, 2) maintains rolling plans of available water resources and canal diversions, and 3) provides the information needed by water users. Such a DSS would help the BVO Syr Darya to advise downstream countries on the summer water releases needed from Toktogul Reservoir early in the season and prepare more accurate plans for the allocation of the basin's water resources throughout the growing season. Most important, the DSS can facilitate improved prediction of water resources and improved clarity of information.

The DSS works based on the existing BVO Syr Darya database for the basin between Toktogul and Chardara reservoirs. It consists of four main sections, which contribute to achieving the following:

- Control over the quality of data inputs provided for the BVO Syr Darya database,
- Analysis of the current and previous water management situation in the Syr Darya Basin,
- Control of implementation of water limitations (limitations are fixed by ICWC agreements), and
- Planning of the water management situation in the basin to determine the most rational use of water by the four countries (Kyrgyzstan, Kazakhstan, Tajikistan and Uzbekistan).

The main principle of DSS is as follows: InputDataControl → Analysis → Forecasting → Planning → Decision

The first step was to develop the DSS for the vegetation season. After testing the DSS jointly with the technical staff of BVO Syr Darya using the actual data, the director of BVO Syr Darya requested that TWEP extend the DSS for a non-vegetation season. DSS modules for both the non-vegetation and vegetation periods were completed. The software tools were installed at the office of BVO Syr Darya. The TWEP team also helped BVO Syr Darya specialists in testing of the DSS tools using actual data.

The use of DSS will contribute to improving and stabilizing the management of the Syr Darya Basin in the context of regional cooperation. The DSS is a practical tool, which helps manage Syr Darya water resources with the objective to improve decision-making on reservoir and canal operations to prevent flooding of lands in Uzbekistan and Kazakhstan, and to increase winter water flows towards the northern Aral Sea. The DSS software tools were used for preparation of a water management plan for both seasons – non-vegetation and vegetation. It has proven its value already by predicting last April this summer's water demand from Uzbekistan and Kazakhstan on Kyrgyzstan's Toktogul Reservoir. The use of DSS during the non-vegetation season, when hydrometeorological forecasts practically are not confirmed, allows BVO Syr Darya to avoid emergency situations in the basin, to prevent flooding of lands in Uzbekistan and Kazakhstan and increase winter water flows towards the Northern Aral Sea.

A detailed User Manual was developed on the use of DSS, which was designed for both the users and the programmers. The User Manual consists of four modules:

1) "Checking and Recovery of Information in the BVO Syr Darya Data Base" Module
2) "Analysis of the Water Resources Formation and Their Use" Module
3) "Forecast of the Water Resources" Module, and
4) "Planning of the Water Management Situation" Module.

Since the DSS operates based on the BVO Syr Darya database, the User Manual consists of the general description of this database. A user can find computer configurations needed to run the DSS. It also includes information on running and operating the DSS software. The four modules are described in detail. Computer print screens, tables and examples can help users to learn DSS quickly and easily. The User Manual was developed in the Russian language and provided to the BVO Syr Darya staff.

On-the-job training courses were conducted for BVO Syr Darya staff. In addition engineers of the Water Distribution department, IT specialists and dispatchers were involved in development of the DSS. This training and user involvement will help BVO Syr Darya to maintain and further develop DSS in the future.

<u>Link the decision support system to better data and information reporting among the basin countries</u>

The lack of openness in water management decision-making among the Syr Darya Basin countries leads to irrational water allocation and distribution, economic losses, friction among the four Syr Darya Basin countries and hardships experienced by the farmers. TWEP's analysis of the existing situation demonstrated the need for regular information

exchange among water management organizations of the Upper, Middle and Lower Syr Darya.

To increase water management efficiency, two draft bilateral protocols on regular information exchange among water management organizations of the Upper, Middle and Lower Syr Darya were prepared. TWEP facilitated the negotiation process related to the draft protocols. The two draft protocols were:

1) A draft protocol between BVO Syr Darya and BVO Aral-Syrdarya on information exchange, and

2) A draft bilateral protocol between BVO Syr Darya and JSC "Power Plants" (Kyrgyzstan) on information exchange.

In May 2005, the bilateral *Protocol on Cooperation in Information Exchange for Water and Energy Resources Management in Syr Darya Basin* was signed between BVO Syr Darya and BVO Aral-Syrdarya. Signing of the protocol will contribute to a more efficient use of the water resources in the lower part of the Syr Darya Basin.

JSC "Electrical Stations" (Kyrgyzstan) suggested developing a draft multilateral agreement on information exchange among water and energy organizations of the Syr Darya Basin based on the draft bilateral protocol between BVO Syr Darya and JSC "Power Plants". JSC "Electrical Stations" began considering a bilateral protocol between BVO Syr Darya and JSC "Electrical Stations".

This subtask linked the DSS to better data and information reporting between the countries. The intent is to diminish friction between the four countries and promote lasting cooperation in water and energy management. To achieve this objective, TWEP worked with counterparts to develop a rolling water management plan to improve information reporting between the countries. The monthly plan includes reports on river flows, planned water allocations and actual withdrawals, and reservoir releases and storages.

To develop the communication information system, TWEP installed the necessary software in the office of BVO Syr Darya and purchased a new Internet account. It is envisaged that the rolling water management plan will be made available through the email communication system among all the stakeholders. Testing run-through of daily information by e-mail between BVO Syr Darya and the Uzbek Hydromet showed that significant improvements could be achieved, first of all in decreasing material input and temporary expenses on information transfer, and also in increasing the quality of the transferred information, in such a way that the human factor will be completely excluded. However, the testing also showed that maximum effectiveness at electronic means of information transfer might be achieved only after development and introduction of databases for information keeping and processing in all basin organizations. Thus it is desirable to apply a uniform technique and software for database development because this will further promote creation of a uniform information space for managing the water and energy resources of the region.

To improve information exchange among Syr Darya Basin countries, NRMP conducted an examination of Kzylkishlak gage station. Kzylkishlak station is located on the Syr Darya downstream of Kayrakum Reservoir in Tajikistan. The station is critical for effective regional water management and data obtained from this site is vital for the operations and activities of organizations such as BVO Syr Darya, Sogdiiskiy Oblvodkhoz and the Tajik Hydromet in

Tajikistan. In 2001, the Kzylkishlak station was one of 25 transboundary sites of the Global Environmental Facility Project where NRMP supported installation of the new water measuring devices and training. In 2003, the station was connected to the meteor burst data communication system designed and installed by the Meteor Burst Communications Corporation with NRMP support. Through this system, data from the Kzylkishlak site became available to all authorized water users in the region.

In 2004, the old pontoon at the Kzylkishlak station deteriorated. It was impossible to use it any longer. This resulted in a lack of precise data from this location and disputes among various regional water management organizations about the reliability of the obtained information. Lack of reliable data from the Kzylkishlak gage station created significant problems with water balance calculations for the upstream part of Syr Darya Basin. The lack of data in turn complicates control of performance of annual agreements between Uzbekistan and Tajikistan on flow regulation in Kayrakum Reservoir and water release from Kayrakum to downstream countries. The necessity to construct a new pontoon became indispensable to ensure control of discharge measurements on a monthly basis. In May 2005, NRMP/TWEP funded the construction and installation of a new pontoon as part of its strategic objectives to improve management of critical water resources in the Central Asia region.

On June 4, 2005, USAID and NRMP with participation of representatives from the core national and interstate water management organizations put the new pontoon in operation at the Kzylkishlak site allowing implementation of accurate discharge measurements at this river section. The data received from Kzylkishlak also improves the quality of the DSS now in operation.

Naryn-Syr Darya Cascade Planning Instrument (NASPI)

One of TWEP's objectives is to assist the Syr Darya Basin countries to get the maximum benefit of the river system. An important step in this direction is to provide a tool that will combine a uniform set of data on the physical characteristics of the river system with a flexible algorithm that can represent its behavior.

During part of 2004, a draft tool – the Naryn Operation Planning Instrument (NOPI) – was developed for planning the operation of Toktogul Reservoir and the series of Kyrgyz power plants known as the Naryn Cascade. On September 22, 2004, TWEP supported a one-day workshop in Almaty held jointly with the representatives of Kazakh Hydromet, the BVO Lower Syr Darya, the Water Resources Committee of the Ministry of Agriculture, and Kazakhprovodkhoz. During the workshop, the management tools developed by TWEP, such as NOPI, DSS and WEN (water-energy nexus spreadsheet) were presented, and issues and requirements for effective operation of the Lower Syr Darya were discussed. The Kazakh officials explained that extending the above software tools to the Lower Syr Darya is a high priority to develop new operating rules for the Chardara Reservoir.

In December 2004, TWEP undertook the development of a planning instrument to assist the countries of the Naryn and Syr Darya basins in understanding the effects of different scenarios of operation for several water storage reservoirs used for irrigation and hydropower. These countries included Uzbekistan, Kazakhstan, Tajikistan and the Kyrgyz Republic. During the December TWEP retreat, it was decided to extend NOPI to include all water controls and demands in the basin up to the Chardara Reservoir. This extended

software tool is called NASPI or the Naryn-Syr Darya Planning Instrument. The first version of the tool was completed in July 2005.

The NASPI software tool is a computer model to simulate the operation of the Syr Darya river system for the purposes of obtaining accurate estimates of water supply for irrigation, power generation from hydroelectric plants and flows in any part of the system. NASPI is a simulation model designed to accurately represent the water balances throughout the system. It can be easily adapted to changes in the physical system, and it is particularly well adapted to estimate the consequences of different policies for operating the river system. NASPI is not a hydraulic model and does not consider the time it takes for the water to get from one point to another. NASPI does not automatically determine how the system should be operated since it is not an optimization model. This last feature is considered critical because it allows full transparency in the selection of a particular operating regime, which is essential to achieve the level of trust required to build political consensus.

NASPI is well suited for the following applications:

- Determine short-term (one season) consequences of a specific policy of reservoir operation under a seasonal hydrologic forecast. The following results can be obtained:
  - the flows at different parts of the system,
  - the level of coverage of irrigation demands,
  - the elevations of the reservoirs, and
  - the production of the power plants.
- Determine long-term consequences of a specific policy of reservoir operation under different segments (several years) of the hydrologic record or the entire hydrologic record (up to 100 years). As a result the following information can be obtained:
  - the probabilities of water deficit for irrigation,
  - the trend in reservoir elevations,
  - the statistics of energy production (firm energy, secondary energy), and
  - the probabilities of energy deficits relative to specified demands.
- Determine the long-term value of new facilities including new reservoirs and power plants. The following results can be obtained:
  - the impact of the new facilities on regulation of water flows to improve the coverage of irrigation demands,
  - the impact of the new facilities in providing additional power through both new power plants or by improving the regulation of flows through existing power plants, and
  - the impact of the new facilities in mitigating flooding by improved regulation of flows.
- Determine the consequences of hydroelectric power plant operations driven by a regional electricity market. The following results can be obtained:

- the impact of specific hydroelectric generation requirements on the level of coverage of water demands for irrigation, and
- the impact of constraints in water releases on the ability of the hydroelectric plants to take full advantage of the electricity market.

The combined use of these different applications provides information that can be useful in negotiation of policies for the operation of the reservoirs. For example, this data can be used as a common reference in developing protocols involving transboundary waters of the Syr Darya Basin. The data can also demonstrate how the natural river regime is being altered by different users of the reservoirs.

NASPI could easily eliminate the effect of existing reservoirs to develop statistics of how irrigation and energy demands would have been served without them. This data can then be compared against different reservoir operation policies to obtain an objective assessment of their impact.

The simulation is performed by an algorithm programmed in FORTRAN language but all the input and output takes place through an electronic spreadsheet prepared in Microsoft Excel. The FORTRAN algorithm represents the river system using three types of standard logical components:

- Reservoir and Variable Head Hydroelectric Plant

  This module represents a dam or water control structure that may release water through three possible routes: 1) the turbines of a power plant that operates under the hydraulic head provided by the reservoir, 2) an outlet located near the bottom of the dam, and 3) a spillway that can only operate when the reservoir is full.

- River Reach

  This component is a segment of river with specific water demands, side inflows and bed losses.

- Constant Head Hydroelectric Plant

  This component represents a hydroelectric plant without storage (run-of-river hydroelectric) so the head remains constant all the time.

In addition there are special logical components to treat specific conditions of the system. All these components are linked by a logical algorithm that defines the physical configuration of Syr Darya system and operates the basin for a given hydrologic period at daily intervals. NASPI is designed to run for hydrologic periods of up to 100 years.

The Excel input/output interface has the following structure:

- Control Panel,
- Data Input forms, and
- Analyzing forms.

The FORTRAN algorithm produces a very large quantity of information that includes every detail of the operation during every day and the user can select different output options that allow a detailed follow up of the operation with a hand calculator for added confidence on the

operation of the model. These daily values are converted into monthly and annual averages and selected values are delivered to the Excel spreadsheet to prepare various graphs and summary tables. Users are allowed to create new graphs and new analyses using outputs. The Excel and FORTRAN components are linked by macros (written on VBA) that provide a smooth connection between them. In this manner, the user needs only open the Excel workbook and use buttons to update input, perform the analysis and refresh the output.

The NASPI software tool was offered to all parties in every country that have a responsibility in the management of Syr Darya Basin water resources. It is anticipated that it will serve as a common reference to discuss operation of the existing system and to plan its future development.

Two courses were designed to transfer this tool to water and energy agencies in the four Syr Darya Basin countries. The first course was called “NASPI Users Course” and was designed for the staff involved in planning. The second course was called “NASPI Programmers Course” and was designed for the staff members who would be involved in maintaining the tool and supporting the planning staff in its use. The first course was held during the week of August 1-5, 2005, and the second course was held during the week of August 8-12, 2005 in Almaty.

The first training program conducted for users of NASPI was attended by 23 participants, and the course for the programmers who will maintain the model was attended by 17 participants. Both courses were delivered by the team involved in development of NASPI. The courses included alternating sessions of theory and practice. During the NASPI Users Course the theory included the design of the model and key aspects of reservoir operation and principles of power planning. In the NASPI Programmers Course the theory included fundamentals of the FORTRAN Language and the use of a modern FORTRAN compiler for Windows called Compaq Visual FORTRAN V6.6.

Each course included participants representing water or energy organizations from each country. Approximately four to seven participants from each country attended the courses. A small number of participants attended both courses.

The Users Course was more homogeneous as all the participants occupied middle or senior management positions in their respective organizations, and all were very familiar with the issues addressed by NASPI. Extensive exchanges of opinions took place during many sessions as the validity of data used was actively discussed among the participants, and scenarios for analysis were proposed by several participants. At the end of the course each organization was requested to develop proposals and recommendations for further enhancement of NASPI. All organizations provided extensive lists of recommendations that were discussed before closing the course.

The Programmers Course had more diverse participants consisting of people with only basic computer skills to highly experienced programmers familiar with advanced computer models. This was a challenge for the instructors during the hands-on sessions, but it was well resolved by the good disposition of the more skilled participants to assist the instructors in helping the less proficient participants. At the end of the course proposals were also welcomed and many participants provided lengthy observations and comments to make NASPI easier to use.

At the end of the Programmers Course, in addition to the training materials and NASPI model, each participant as a representative of their organization received the Compaq Visual FORTRAN software, which includes installation disk Compaq Visual FORTRAN 6.6 Standard Edition, Language Reference Manual, and Installation Guide. The NASPI model was designed as bilingual software with provisions for selecting English or Russian.

The participants in the training programs agreed that NASPI was a very good tool to provide accurate representation of the river system and meet the need to provide a transparent and easy-to-use model. During the trainings all the participants interacted extensively among themselves and indicated that the training was an invaluable opportunity to know and exchange views among technical staff of the four countries. The participants were interested in the further use of NASPI, but they also noted the importance of testing NASPI at their respective organizations during a certain period of time.

TWEP took into consideration proposals and recommendations of the specialists from regional and national water and energy organizations. TWEP specialists worked jointly with experts from these water and energy organizations to determine and prioritize directions for further software development to improve NASPI's capabilities and adjustment to operational conditions. Priority was given to those proposals that would improve NASPI application by users in their real work for identifying problems regularly occurring in the Syr Darya Basin. Taking into consideration the problems related to flooding of significant territories in the lower part of Syr Darya, which occurs annually due to the limited watercourse throughput, most attention was focused on development of an algorithm for allocation of increased water releases from the Toktogul Reservoir to the Chardara-Arnasai node and maximum water flow release from the Chardara Reservoir to the northern part of the Aral Sea.

According to proposals received from the Kazakhstan specialists, for the purposes of simulation of potential situations occurring during the winter season downstream on the Syr Darya River, information on the river reach between the Chardara Reservoir and the Aral Sea was expanded. The four most important river reaches downstream from the Chardara Reservoir were identified, which allows the user to develop different options for a non-emergency maximum water release taking into consideration the watercourse throughput capacity and waterworks facilities after ice formation during the freezing period. The NASPI calculation scheme also included the northern part of the Aral Sea, which would allow simulation to imitate the dynamics of changing the volumes and levels of water during different hydrological conditions and to determine duration of the period for accumulation of maximum volumes of water in accordance with technical characteristics of NAS (the Northern Aral Sea model), developed by the World Bank's Syr Darya and Northern Aral Sea (SYNAS) project.

According to proposals of the Uzbekistan specialists, data on the Aidarkul Lake was added to the software tool. During recent years, a critical situation occurred at Aidarkul Lake because of a sharp and significant increase of water levels as a result of regular water releases from the Chardara Reservoir during the winter period. In addition, data on aggregate water release of the reservoirs to Aidarkul Lake from the territory of Golodnaya Steppe was added to the software. To develop an optimum alternative for allocation of the increased water inflows to the Chardara-Arnasai node and to exclude emergency situations, monthly indicators for water level control in the water reservoirs, as well as water releases downstream from the Chardara Reservoir, and water inflow to the Arnasai Reservoir and Aidarkul saddle were introduced.

For a more efficient representation and analysis of the calculation results, three types of summary tables were developed. The tables include monthly, seasonal and annual data on the use of transboundary water resources for irrigation needs, as well as the volumes of electricity generation at the main hydropower stations within the Syr Darya Basin with the calculation of electricity generation and consumption in the Kyrgyz Republic. These tables will allow users to determine the most acceptable schedule for operation of the Naryn-Syr Darya Cascade reservoirs under specific hydrological conditions, taking into consideration the electric power surplus and deficit generated at the Naryn Cascade hydropower plants versus the electricity demand of the Kyrgyzstan economy.

The NASPI interface was significantly improved based on proposals and data provided by the users. First of all this was done to make input data retrieval and output data processing more effective. In accordance with the requests of the NASPI training participants, a water management period (from April until March) was taken as the basis for calculations. The results of the calculations were broken into different categories for the vegetation and non-vegetation periods. In addition, the ability to make calculations for the calendar year, as well as for the hydrological year, was preserved. In addition, the ability to make calculations from a certain date to another certain date in the YY/MM/DD format was added to allow users to make calculations for any time period.

The volume of output data was expanded for a complete account of river water flow. The software now takes into consideration water evaporation from the surface of reservoirs, water inflow to the Northern Aral Sea, and water releases to the Aidarkul saddle.

TWEP specialists developed a third scheme for modeling operation of the Naryn-Syr Darya Cascade that focuses on irrigation. Currently, a user can use NASPI to simulate the operation of the Naryn-Syr Darya Cascade reservoirs using three different schemes: 1) irrigation and energy, 2) energy (with installation of targeted water releases from the Toktogul reservoir), and 3) irrigation.

After these revisions, TWEP specialists visited water and energy organizations in Kazakhstan, Kyrgyzstan and Uzbekistan. The newly revised version of NASPI was introduced to the specialists of these organizations. The TWEP specialists also provided assistance to the specialists of these organizations in NASPI and Fortran installation and detailed consultations were offered on the use of the model under varying terms and conditions. To adjust the software tool to the requirements of each organization, test calculations were made jointly with the specialists of these organizations for various hydrological conditions in combination with different schemes of the Toktogul Reservoir operation. The test results showed that NASPI could be used as a tool for planning operation of the Naryn-Syr Darya Cascade reservoirs.

The representatives of the water and energy organizations noted that for reliable work of the model it is important to make NASPI an officially recognized (legal) tool and to organize sustainable data sharing, which is required for effective NASPI use and operation. It is also important to develop an algorithm for distribution of potential water deficits among the users, as well as to take into consideration the sanitary and environmental water releases from the reservoirs.

6. RESOLUTION OF HYDROMETEOROLOGICAL STATION ISSUES

Near the end of TWEP, USAID included some additional work to resolve issues that had arisen with hydrometeorological systems implemented to support the goals of NRMP and TWEP. This section summarizes these efforts at troubleshooting, maintenance and repair for hydrometeorological systems installed in Uzbekistan and Tajikistan under NRMP and TWEP.

Intellectual Portable Device (IPD) problem

Six automated meteorological stations supplied by Campbell Scientific Instruments (CSI) were previously delivered and installed within Uzbekistan. All those stations were designed to provide communication to Commcenters via Radio Batch Link. CSI data loggers and IPDs (manufactured by "Incom" Ltd, Tomsk) are principal components of Radio Batch Link. CSI data loggers interface to IPD via two microchips. The first chip runs and provides control to the operating system, and the second chip runs data processing software. The system chip has been fully operational but the software chips were not debugged yet. The long-term problem with the software chips debugging occurred because the chips provider had no data logger in their laboratory and had to emulate the process of data transmission to the IPD. Such techniques always create the risk of getting corrupted data from the emulator. The chips delivered by the provider needed to be verified by testing the IPD and data logger during real communication sessions. Once the chips were debugged, they were delivered to remote stations to replace the older chips.

Two hydroposts equipped with CSI data loggers problem

Two hydroposts (Uchkurgan and Uchtepe) play a key role in water balance calculation for the Naryn-Syr Darya Cascade. These hydroposts were equipped with automated water level gages and connected to the meteor burst data communication system designed and installed by the Meteor Burst Communications Corporation (MCC). The two hydroposts had reported data on water level fluctuations before July 2005 when they became non-functional. The installed equipment consists of electronic and mechanical parts. Sometimes breakage or misuse the mechanical parts can cause the fault of electrical or electronic parts. In this case, the equipment needed to be recalibrated again and local staff could not perform this procedure. These two hydroposts were visited and their non-functional status was fixed.

CSI/MCC interface requirement problem and SR50 sensor reinstallation

The CSI/MCC network was already deployed and its functionalities demonstrated and proven during its demonstration stage. Afterward, follow-up steps were taken to make this network more stable and productive. These steps were to be done in accordance with CSI/MCC requirements for interface and communication. Unfortunately, this principle was not observed at a few remote stations, which were reporting truncated data bursts. This abnormal situation was fixed by reprogramming the data loggers to meet MCC requirements for CSI data output.

In addition, the data collection potential of key remote stations was improved through installation of additional means of data measurement like Rocket Gages, Snow Pillows, and Ultrasonic Gages. All of these are equipped with highly precise sensors that give reliable

readings when calibrated and installed according to manual directions. Two pressure transducers were recalibrated and an SR50 ultrasonic meter was reinstalled because these actions were not completed during the specialist's last visit during June 2005. The snow blanket and refrozen ice crust under snow made an access to these sensors impossible in June 2005. The severe environment has a significant impact on a sensor's installation in addition to the restricting access to the site. The TWEP specialist calibrated snow measurement equipment installed at the Fedchenko Glacier station in Tajikistan and placed the snow depth meter in a more effective location.

CSI and manually collected data comparison

The principles and techniques of data measurement by automated stations are quite different from manual data measurements that are currently in wider application in the Central Asia National Hydrometeorological Services. Implementation of the automated hydrometeorological station network implies that manual data measurements will be gradually replaced with automated data measurements. The necessary modification of existing data measurement principles and techniques needed to be proven through a comparison of the adequacy of automated data to manually collected data. A comparison of automated data to manually collected data was accomplished by doing a statistical analysis of the CSI and manual data time series collected simultaneously. It was necessary that this analysis be done to authorize replacement of the manual data measurements with automated measurements.

All sites equipped with the specifically designed equipment will be supplied with brief and user-friendly recommendations on rules and directions for using the new equipment to avoid misuse. It is planned that each station supplied with CSI/MCC equipment will have recommendations on troubleshooting, maintenance and repair techniques.

7. RECOMMENDATIONS

The TWEP team prepared recommendations for the next steps for major activities. Also provided below is a list of organizations that are involved in operating the river system in the Syr Darya Basin.

1. Development and replication of the Decision Support System

The DSS has already proven its value. But it would be useful to extend the DSS to increase its capacity. To that end it is necessary to develop several modules: module "Hydropower", module "Water Quality", and module "Geographical Information System (GIS) for the Syr Darya Basin".

The DSS was demonstrated at several seminars and trainings. Based on the opinions of participants at the meetings, similar DSS models could be developed for these organizations: BVO Aral-Syrdarya (it manages the lower Syr Darya down from the Chardara Reservoir to the Aral Sea), UDC "Energiya", and BVO Amu Darya (this organization manages water resources of the Amu Darya Basin).

The next step would be to reach an integration of the DSS developed for BVO Syr Darya and the three proposed DSS models that could be developed for BVO Aral-Syrdarya, BVO Amu Darya and UDC "Energiya". This integrated system could generate a Central DSS for the Aral Sea Basin, which will improve water and energy resources management of Aral Sea Basin.

2. International Agreement on Information Exchange

Negotiations should be continued on technical aspects of information exchange to eventually reach a consensus for a multilateral agreement on information exchange among water and energy organizations of the Syr Darya Basin. However, it will be a challenge to get this multilateral agreement signed by all the countries. More technical assistance may be required to achieve this goal in the future. The list of regional and national organizations that should be included in discussions of the multilateral agreement on information exchange includes: BVO Syr Darya, Unified Dispatch Center UDC "Energiya," Water Resources and Processing Industry Ministry (KG), JSC "Power Plants" (KG), JSC "KEGOK" (KZ), Water committee (KZ), OSHPC "Barki Tojik" (TJ), Ministry of Reclamation and Water Resources (TJ), Water Resources Department of the Ministry of Agriculture and Water Resources (UZ), and SJSC "Uzbekenergo" (UZ).

After the proposed multilateral agreement is signed, USAID should continue technical assistance to these organizations for implementing the protocol and ensuring efficient information exchange to improve natural resources management in the region.

3. Development, application, support and replication of the Naryn-Syr Darya Cascade Planning Instrument

For further development, application and support of NASPI it is necessary to:

- Conduct additional training on NASPI from November 2005 to February 2006.
- Organize discussions about the principles of using NASPI for expert calculations regarding water and energy issues in the Syr Darya Basin and develop a protocol for further NASPI development and support.
- Select local consultants, and organize and conduct working meetings of local consultants on a regular basis (two or three times a year).
- Create and support a Working Group on NASPI. Responsibilities of the Working Group will include:
  - NASPI development;
  - information exchange support;
  - coordination of activities among all the stakeholders interested in using and improving NASPI;
  - assist the water and energy organizations of the Syr Darya Basin in development of rules for long-term management of reservoirs of the Naryn Cascade (taking into account requirements of ecology, hydropower and irrigation); and
  - assist the organizations to come to a formal agreement on the rules for long-term management of reservoirs of the Naryn Cascade.
- Purchase computers for NASPI installation and application.

The Tajik group of participants in conjunction with the International Fund for Saving the Aral Sea (IFAS) suggested development of a tool similar to the NASPI model for the Amu Darya Basin to improve water management of Amu Darya water resources. If a model for the Amu Darya Basin is developed, the Unified Dispatch Center "Energiya" will have an opportunity to plan operation of the whole regional energy system for Central Asia, using a unified methodology for planning and managing the water resources of the region to get the most beneficial operation of reservoirs and to get an operational consensus among all the interested countries, including the ecological requirements.

4. Develop databases for the main organizations that are involved in management of water resources in the Syr Darya Basin

Currently, most organizations in the Syr Darya Basin use their individual standards for collecting and analyzing data. Most of the data are collected in paper books. Then part of the information is transferred to Excel workbooks. Since there is no common system for identification of energy and water structures it is difficult to share data automatically between all the stakeholders using email and Internet connections. Most of the organizations use telephone and radio voice connection for data transmission.

All these problems can be solved by developing integrated databases for use among all of these organizations. These databases should have similar structures and similar principles. Instead of each organization using its own standards for analyzing data, development of common tools for analyzing data can improve the quality, timeliness and efficiency of decision-making for water resources planning and management in the basin.

The proposed integrated databases could be installed at Dispatch Centers and main departments. It would be useful to develop summary output forms for high-level managers of the organizations. Development of line schematics can strengthen the databases. Development of the databases, analysis tools and tools for data transmission will improve water and energy cooperation among the basin countries because all the stakeholders will get information on time, on a regular basis and in a more accurate way.

Some organizations such as BVO Syr Darya and MAWR (Water Resources Department of the Ministry of Agriculture and Water Resources of the Republic of Uzbekistan) have already implemented Information Management Systems, which includes databases, analysis tools, modules for various calculations and data exchange tools. Both of these Information Management Systems were developed with NRMP support. This experience can be used for development of additional databases.

List of organizations that are involved in water resources planning and management for the Syr Darya Basin:

Kyrgyz Republic
JSC “Power Plants”
JSC “National Grids”
JSC “Electrical Stations”
Water Resources Department of Ministry of Agriculture, Water Resources and Processing Industry of the Kyrgyz Republic
Republic of Kazakhstan
Dispatch Department of JSC “KEGOK”
KOREM
Water committee of Kazakhstan
BVO Aral-Syrdarya
Chardara HEP Management Authority
Republic of Tajikistan
Ministry of Reclamation and Water Resources of the Republic of Tajikistan
Ministry of Energy of the Republic of Tajikistan
The Open Stock Holding Power Company “Barki Tojik”
Kayrakum HEP Management Authority
Republic of Uzbekistan
SJSC “Uzbekenergo”
Water Resources Department of Ministry of Agriculture and Water Resources of the Republic of Uzbekistan
Regional organizations
International Fund for Saving the Aral Sea (IFAS)
Scientific Information Center at the Interstate Commission for Water Coordination (SIC-ICWC)

Basin Water Management Organization: BVO Syr Darya
Unified Dispatch Center UDC “Energiya”
International Water and Energy Consortium (IWEC)
Hydromets of the four Republics (national hydrometeorological services)